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Content Based
Chemical Engineering

PAPER1 - Pulp Suspensions - find pressure drop, flow known

BASIS: GOULDS PUMP MANUAL and CRANE TECHNICAL PAPER 410

NOTE: Always begin a new case by retrieving the original file. Direct entry of data in cells that originally contain table lookups could cause functions to be lost, or incorrect calculations. I format cells requiring entry colored **RED**; calculated values are black.

1.) Enter identification at [C4]
2.) Enter pulp type at [C5], use [=], then go to type name in the pulp/pipe lookup table at [A48].
3.) Enter pipe ID at [C8], use [=], then go to pipe table. eg. [=B84] is the ID for 6" schd 10 (imperial), or directly enter if not in table.
4.) Enter piping straight length at [C9].
5.) Enter inlet and outlet elevations at [C11] & [C12].
6.) Enter the volumetric flow at [G8].
7.) Enter pulp temperature at [D17].
8.) Enter per cent consistency at [D17].
9.) Enter the correction factor for the pulp beating at [D18] obtain this from the Goulds Manual or other sources. (typ. values =.96 - 1.37).
10.) Enter the design safety factor at [D19].
Enter the number of each valve & fitting just to their left, e.g. [A29]...[A33] & [E29]...[E33]. Misc items:for any item where `K' is not known but an equivalent length of pipe is, enter the value at [G36] in FEET (imperial) or in METER (metric).
11.) Entrance and exit losses: normally 0.5 and 1.0, enter at [C37] and [C38] as desired.

The program calculates the bulk velocity, maximum velocity, and the onset of drag. Then displays the results in cells [G10]...[G12]. The appropriate equation is then utilized in the spreadsheet and equation type displayed at cell [F21] based on the bulk velocity friction.

Head loss per 100 feet (imperial) or per 100 meter (metric) is calculated and shown at [G41].
The delta P in psig (imperial) or kPa (metric) for this system is calculated and shown at [D44].

Print out using direct Excel commands. This application is provided by Chemical Engineers Resource Website, vischeresources.com for additional selections.

Print out using direct EXCEL commands.

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PAPER1 - Pulp Suspensions - find pressure drop, flow known

System : Wire Layer Stock Pump
Pulp : Bleach kraft pine dried & reslurry

System			Flow		
Pipe ID:	8.329	inches	Volumetric Flow, Q:	2000	gpm
Length:	76	feet	Tons Per Day:	420.4	tpd
Material:	Stainless Steel		Stock Bulk Velocity:	11.78	fps
Elevation in:	12	feet	Maximum Velocity, Vmax:	3.63	fps
Elevation out:	8	feet	Onset of Drag, Vw:	23.11	fps

Stock Parameters

temp. =	90.0	ºF	exp α =	0.31
% consistency =	3.500		exp β =	1.81
F4, beat. factor =	1		exp τ =	-1.34
F5, safety factor =	1		coefficient, K =	8.8

Bulk Velocity Friction Regio 2 (V,w > V,bulk > V,max)

Region #1; (V,max > V,bulk) ..... : $\delta H_L = F * K * V^{\alpha} * C^{\beta} * D^{\tau}$

Region #2; (V,w > V,bulk > V,max) ... : $\delta H_L = F * K * V_{max}^{\alpha} * C^{\beta} * D^{\tau}$

Region #3; (V,bulk > V,w) ..... : $\delta H_L = 0.579 * V^{1.75} * D^{-1.25}$

Correction Factor, F: = 1.28 **Fitting Friction Factor, ft =** 0.0141

Valves	K	H_L	Fittings	K	H_L
2 gate valve	0.226	0.487	2 thru `T'	0.566	1.218
0 ball valve	0.000	0.000	2 branch`T'	1.697	3.654
0 plug valve	0.000	0.000	5 long 90º	0.990	2.132
2 3W plug thru	0.848	1.827	2 long 45º	0.283	0.609
2 3W plug brnch	2.545	5.482			
valves total	3.620	7.796	misc. equip. ΔP =	12.000	psig
fittings total =	3.535	7.614	misc. equip. length =	0.000	feet
entrance loss	0.500	1.077	final length =	76.000	feet
exit loss	1.000	2.154	elevation loss =	-1.734	psig
misc. K	0.000	0.000			
Σ K =	12.2	26.3	head loss/100 ft =	9.50	feet

ΔP = 24.779383 psi, or 57.1 equiv feet of head

04/24/04

PAPER1 - Pulp Suspensions - find pressure drop, flow known

System : Wire Layer Stock Pump
Pulp : Bleach kraft pine dried & reslurry

System			Flow		
Pipe ID:	211.580	millimeter	Volumetric Flow, Q:	0.1261804	meter^3/sec
Length:	23.1648	meter	Tons Per Day:	381.7039	metric ton/day
Material:	Stainless Steel		Stock Bulk Velocity:	3.59	meter/sec
Elevation in:	3.6576	meter	Maximum Velocity, Vmax:	1.11	meter/sec
Elevation out:	2.4384	meter	Onset of Drag, Vw:	7.05	meter/sec

Stock Parameters

temp. =	32.2	ºC	exp α =	0.31
% consistency =	3.500		exp β =	1.81
F4, beat. factor =	1		exp τ =	-1.34
F5, safety factor =	1		coefficient, K =	970

Bulk Velocity Friction Regio 2 (V,w > V,bulk > V,max)

Region #1; (V,max > V,bulk) ..... : $\delta H_L = F * K * V^{\alpha} * C^{\beta} * D^{\tau}$

Region #2; (V,w > V,bulk > V,max) ... : $\delta H_L = F * K * V_{max}^{\alpha} * C^{\beta} * D^{\tau}$

Region #3; (V,bulk > V,w) ..... : $\delta H_L = 264 * V^{1.75} * D^{-1.25}$

Correction Factor, F: = 1.28 **Fitting Friction Factor, *f*t =** 0.0140

Valves	K	H_L	Fittings	K	H_L
2 gate valve	0.224	0.147	2 thru `T'	0.560	0.367
0 ball valve	0.000	0.000	2 branch`T'	1.680	1.102
0 plug valve	0.000	0.000	5 long 90º	0.980	0.643
2 3W plug thru	0.840	0.551	2 long 45º	0.280	0.184
2 3W plug brnch	2.520	1.654			
valves total	3.584	2.352	misc. equip. ΔP =	82.737	kPa
fittings total =	3.500	2.297	misc. equip. length =	0.000	meter
entrance loss	0.500	0.328	final length =	23.165	meter
exit loss	1.000	0.656	elevation loss =	-1.219	meter
misc. K	0.000	0.000			
Σ K =	12.1	7.9	head loss/100 meter =	9.50	meter

ΔP = 170.13397 kPa, or 17.3 equiv meter of head

Pulp Type	Pipe Material	K'	s	F2	K	a	b	g
Unbeaten aspen sulfite never dried	Stainless Steel	0.85	1.6	1.25	5.3	0.36	2.14	-1.04
Lg fiber kraft never dried CSF=725	PVC	0.98	1.85	1	11.8	0.31	1.81	-1.34
Lg fiber kraft never dried CSF=725	Stainless Steel	0.89	1.5	1.25	11.8	0.31	1.81	-1.34
Lg fiber kraft never dried CSF=650	PVC	0.85	1.9	1	11.3	0.31	1.81	-1.34
Lg fiber kraft never dried CSF=550	PVC	0.75	1.65	1	12.1	0.31	1.81	-1.34
Lg fiber kraft never dried CSF=260	PVC	0.75	1.8	1	17	0.31	1.81	-1.34
Bleach kraft pine dried & reslurry-	PVC	0.79	1.5	1	8.8	0.31	1.81	-1.34
Bleach kraft pine dried & reslurry	Stainless Steel	0.59	1.45	1.25	8.8	0.31	1.81	-1.34
Lg fiber kraft dried & reslurried	PVC	0.49	1.8	1	9.4	0.31	1.81	-1.34
Kraft birch dried and reslurried	PVC	0.69	1.3	1	5.2	0.27	1.78	-1.08
Stone groundwood CSF=114	PVC	4	1.4	1	3.81	0.27	2.37	-0.85
Refiner groundwood CSF=150	PVC	4	1.4	1	3.4	0.18	2.34	-1.09
Newsprint broke CSF=75	PVC	4	1.4	1	5.19	0.36	1.91	-0.082
Refiner groundwood (hardboard)	PVC	4	1.4	1	2.3	0.23	2.21	-1.29
Refiner groundwood (insulate board)	PVC	4	1.4	1	1.4	0.32	2.19	-1.16
Hardwood NSSC CSF=620	PVC	0.59	1.8	1	4.56	0.43	2.31	-1.2
Unbleached sulfite	Copper	0.98	1.2	1.25	12.69	0.36	1.89	-1.33
Bleached sulfite	Copper	0.98	1.2	1.25	11.4	0.36	1.89	-1.33
Kraft	Copper	0.98	1.2	1.25	11.4	0.36	1.89	-1.33
Bleached straw	Copper	0.98	1.2	1.25	11.4	0.36	1.89	-1.33
Unbleached straw	Copper	0.98	1.2	1.25	5.7	0.36	1.89	-1.33
Cooked groundwood	Copper	0.75	1.8	1.25	6.2	0.43	2.31	-1.2
Soda	Steel	4	1.4	1.25	6.5	0.36	1.85	-1.04

Pipe Data Table

nominal diameter	ID schd 10S	ID schd 40	ID schd 80
1/2	0.674	0.622	0.546
3/4	0.884	0.824	0.742
1	1.097	1.049	0.957
1 1/4	1.422	1.380	1.278
1 1/2	1.682	1.610	1.500
2	2.157	2.067	1.939
2 1/2	2.635	2.469	2.323
3	3.260	3.068	2.900
3 1/2	3.760	3.548	3.364
4	4.260	4.026	3.826
6	6.357	6.065	5.761
8	8.329	7.981	7.625
10	10.420	10.020	9.562
12	12.390	11.938	11.374
14	13.624	13.124	12.500
16	15.624	15.000	14.312
18	17.624	16.867	16.124
20	19.564	18.812	17.938
24	23.500	22.624	21.562

ipe Friction Data - Crane TP-41

Nominal Size	Friction Factor, *ft*	Next Pipe Size
0.2	0.037	0.300
0.3	0.033	0.400
0.4	0.030	0.500
0.5	0.028	0.750
0.75	0.025	1.000
1	0.023	1.500
1.5	0.021	2.000
2	0.019	2.500
2.5	0.018	3.000
3	0.018	3.500
3.5	0.017	4.000
4	0.017	5.000
5	0.016	6.000
6	0.015	8.000
8	0.014	10.000
10	0.014	12.000
12	0.013	14.000
14	0.013	16.000
16	0.012	20.000
20	0.012	24.000
24	0.011	36.000
36	0.011	48.000
48	0.010	60.000

Factor, *ft* Interpolation	
8.00	0.0142
8.329	0.0141
10.00	0.0136